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AUTHOR Holzemer, William L.
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ABSTRACT

This validation study investigated the instructional effectiveness of seven programmed booklets on selected topics in drug education against the criterion of student achievement. A post-test-only control group design was used. Six of the seven booklets were found to be instructionally effective as measured by objective referenced tests. The problems of doing this type of study are discussed as an aspect of the work of an instructional development agency's formative evaluation staff. (Author)

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William L. Holzemer

Syracuse University

The developer of programmed instruction is required to initiate the empirical validation of his materials to determine their instructional effectiveness. Yet the process of validation frequently becomes so complex that the developers often retreat from the task because of constraints of interest, time, and money. Despite the recommendations of the Joint Committee on Programmed Instruction (1966) and others (Glaser, 1966; Komoski, 1966; Popham, 1970), the developer's responsibility for validation has often been ignored or shifted to a publisher or buyer.

Popham (1970) stated that "validation refers to the accumulation of empirical evidence regarding the success of given materials in promoting attainment of their particular instructional effectiveness" (p. 217). The four types of empirical evidence considered most important are (1) changes in achievement, (2) amount of time to completion, (3) percentage of errors for each frame (in linear programming), and (4) student attitudes (Jacobs, 1966). The one category which is generally neglected in validation studies is achievement, and consequently achievement is frequently omitted as a criterion for selection (Garner and Zerrip, Jr., 1971). These representative problems of the

developer are illustrated in the validation of programmed materials described below.

The School of Social Work in conjunction with the Center for Instructional Development at Syracuse University developed an interdisciplinary course, Drugs in Perspective. The course is described in the Student Manual in the following manner:

> Drugs in Perspective is designed to provide you with a broad, objective knowledge base in the area of drugs and their use in contemporary society, allowing you to examine your own attitudes as well as others in relation to drugs. The course is divided into the following modules: Defining the Drug Problem, Pharmacological Aspects of Drugs, Drugs and the Law, and Major Treatment Approaches.
>
> Drugs in Perspective utilizes various educational techniques, including role playing, self-instructional booklets, slide/tape presentations, and simulation exercises, while allowing you to move at your own pace.
>
> The course which is open to all students (freshmen through graduate students) is part of a total drug education project utilizing community and University resources. (Higley and Eickmann, 1973, p. 3).

Eleven topic-specific branching programmed instructional booklets were produced for the Module, Pharmacological Aspects of Drugs.

The booklets were carefully researched by graduate students in the School of Social Work. Two consulting faculty in neurochemistry and neuropharmacology from Upstate Medical Center, State University of New York, approved the booklets' content. Three community agencies dealing with drug prevention, education, and crises also examined and approved the booklets. Students' affective responses to the booklets were examined with a short six-item questionnaire and interviews.

At the request of the project director and the development staff, a validation study was initiated to examine student achievement. Only

seven of the eleven booklets were initially examined in order to establish acceptable power in the statistical analysis. The seven booklets simultaneously examined were titled* Amphetamines, Barbiturates, Caffeine, Cocaine, Drug Definitions, Marijuana, and Tranquilizers.

*See appendix for a list of Staff for Drugs in Perspective and a list of authors for the booklets.

Design

A post-test-only design (Campbell and Stanley, 1963) was chosen because of its strong internal validity and its applicability to existing conditions. Table 1 presents a schematic of the post-test-only design.

TABLE 1

POST-TEST-ONLY CONTROL GROUP DESIGN

Experimental	R	X	O_1
Control	R		O_2

R = randomization

X = treatment

O_1 and O_2 = post-test

Subjects

The 412 students enrolled in the course, Social Work 250/550, Drugs in Perspective, were the subjects. 212 subjects were matched on sex and college class and randomly assigned by pairs to four treatment conditions (Caffeine, Cocaine, Tranquilizers, and Marijuana). SAT-Verbal scores were available for 200 students; these subjects were matched on SAT-Verbal, sex, and college class and randomly assigned by pairs to three treatment conditions (Amphetamines, Barbiturates, and Drug Definitions). Tables 2 and 3 present an analysis of the subjects within treatment conditions by sex, college class, and SAT-Verbal scores.

TABLE 2

NUMBER OF SUBJECTS BY SEX AND COLLEGE CLASS IN TREATMENT CONDITIONS

BOOKLET	SEX	F	S	J	SR	G	X	T	F	S	J	SR	G	X	T
		Experimental							Control						
Amphetamines	M	1	3	6	1	0	0	11	0	1	5	0	0	0	6
	F	1	5	6	1	0	0	13	3	5	6	0	0	0	14
Barbiturates	M	1	0	4	1	0	0	6	1	2	4	0	1	0	8
	F	2	4	5	0	0	0	11	1	3	7	0	0	0	11
Caffeine	M	2	2	3	2	1	1	11	0	2	0	4	1	2	9
	F	0	2	3	4	1	2	12	0	1	1	3	2	1	8
Cocaine	M	1	0	1	2	1	0	5	0	0	1	3	1	0	5
	F	1	1	0	2	1	0	5	0	1	2	3	1	1	8
Drug Definitions	M	1	1	5	1	0	0	8	1	3	4	0	0	1	9
	F	3	2	3	0	0	2	10	4	2	5	0	1	0	12
Marijuana	M	0	1	1	4	0	1	7	0	1	2	2	2	0	7
	F	0	2	0	5	2	1	10	1	1	1	3	0	0	6
Tranquilizers	M	0	3	1	7	1	0	12	0	3	2	6	1	1	13
	F	1	1	2	3	3	2	12	1	2	2	2	1	1	9

F = freahman; S = sophomore; J = junior; SR = senior; G = graduate student; X = unknown; T - total

TABLE 3

Range, Means, Standard Deviations and t Statistics of SAT-Verbal Scores
For Three Treatment Conditions

BOOKLET	Experimental			Control					
	Range	$\bar{X}$	SD	Range	$\bar{X}$	SD	t	df	
Amphetamines	403 - 679	538.090	72.738	381 - 666	505.450	83.051	1.316	40	NS
Barbiturates	426 - 648	523.187	71.185	436 - 648	538.444	66.590	0.623	32	NS
Drug Definitions	432 - 680	519.466	73.427	361 - 592	498.052	58.630	0.892	32	NS

Procedure

One 50-minute class period was devoted to the validation study. Each student upon entering one of the 12 sections received a packet with his name on it. The instructor read standardized instructions asking the students to remove an INSTRUCTION SHEET from their packet and to follow the instructions. Students were informed that their test scores would not be given to their instructors.

Students assigned to one of the seven experimental groups were instructed to remove the programmed booklet and read it. Upon completion of the booklet, they were instructed to remove the objective referenced test and complete it. Returning all materials to their packet, the students could then leave the room. The control groups were instructed to remove the objective referenced test, complete it, and return it to the packet. They were then instructed to remove the programmed booklet and read it; upon completion of the booklet they were allowed to leave the room. The control groups were instructed to read a booklet (corresponding to their post-test) in order to minimize the effect of intra-session contamination.

Content Validity

Each programmed booklet contains specific learner objectives within the text. A graduate student teaching in the course wrote the objective referenced test items from these objectives. From Table 4, it becomes apparent that the objectives were written with different degrees of specificity. For example, each learner objective in the booklet Drug Definitions was portrayed by one test item; however,

three test items were necessary to portray each learner objective in the booklet Barbiturates. The author of the test items carefully arrayed the learner objectives with the minimum test items necessary and these in turn were reviewed by the researcher.

TABLE 4

Listing of Number of Pages, Approximate Time to Completion, Number of Learner Objectives, and Number of Test Items per Booklet

Booklet	Number of pages	Approximate Time to Completion	Number of Stated Objectives	Number of Test Items
Amphetamines	86	40 - 50 min.	5	28
Barbiturates	40	20 - 30	8	24
Caffeine	20	10 - 15	3	5
Cocaine	80	40 - 50	4	28
Drug Definitions	50	30 - 45	15	15
Marijuana	66	30 - 45	5	19
Tranquilizers	60	30 - 45	14	19

Analysis

Students' responses were collected in machine-scoreable format, and the data were rendered for analysis. Means, standard deviations, and t statistics were calculated for the significances of the difference between the experimental and control group means for each treatment condition.

RESULTS

The developer of these programmed booklets can be reasonably confident that students did learn from the material. The results of the validation study (Table 5) show that six of the seven experimental group means were significantly different from the control groups.

The marijuana booklet did not show a significant difference and this can be interpreted in two ways. First, it is quite probable that the students knew a great deal about marijuana prior to the treatment and that the strength of this knowledge was so great that the booklet could not show a significant increase. Upon examination of the answer sheets for the marijuana booklet, a second explanation becomes plausible. Three of the answer sheets were found to be irregular. Two students in the experimental group only scored 3 correct responses, whereas the mean was 12.4; and one student in the control group scored zero, whereas the mean was 11.4. All the students attempted all 19 questions on the marijuana post-test except these three; they attempted 9, 18, and 5 respectively. Removing these three scores, the marijuana booklet shows a significant difference. It would seem that these three

TABLE 5

Means, Standard Deviations and t Statistics for Experimental and Control Groups for Seven Programmed Booklets

Booklet	Experimental			Control					
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t	df	
Amphetamines	24	19.125	5.418	20	14.450	2.654	3.646	42	**
Barbiturates	17	18.764	2.818	19	14.157	2.345	5.153	34	**
Caffeine	23	3.695	0.687	17	2.764	1.001	3.232	38	*
Cocaine	10	21.800	1.600	13	12.846	2.412	10.221	21	**
Drug Definitions	18	12.444	1.921	21	8.660	2.054	5.776	37	**
Marijuana	17	12.235	3.556	13	10.538	3.586	1.244	28	NS
(with 3 scores removed)	15	13.466	1.203	12	11.416	1.977	3.032	25	*
Tranquilizers	24	11.458	3.081	22	5.000	1.381	7.709	44	**

*p .005

**p .001

students were uncooperative for one reason or another

The absenteeism was approximately 40% for the required class period for this study. Those results with fewer than 20 students per group need to be cautiously interpreted because of the loss of power.

DISCUSSION

The recommendations of the Joint Committee on Programmed Instruction state that one of the developer's responsibilities is to determine the instructional effectiveness of materials. This validation study investigated the instructional effectiveness of programmed booklets against the criterion of student achievement, and the process of carrying out this study brought into question the Committee's recommendation. Having conducted such a study within the naturalistic situation, the researcher is forced to question whether the extreme effort required was really worthwhile.

Many problems were encountered in this validation study. The initial concern was to formulate a research design that would provide the necessary information for the developer and fulfill the criteria of internal and external validity for the evaluator. After the research design was chosen, major logistical problems arose such as meeting press deadlines, obtaining SAT-Verbal scores, and compiling individualized packets. The Center for Instructional Development made sufficient time and resources available to the evaluation staff to conduct such a rigorous validation study. It is interesting to speculate about the desirability of the information obtained from this study in relation to the costs.

As a result of the extensive development work on the booklets and the review of the preliminary evaluation data, the developer and project coordinator were convinced of the instructional effectiveness of these materials prior to the investigation of student achievement. However, they wanted objective evidence to support this intuitive claim. The validation study supported the claim of instructional effectiveness and, therefore, increased credibility with students, faculty, community agencies and prospective publishers. The costs to the Center for conducting the study must be examined in relationship to this credibility gain.

It is difficult to know the benefits of the study for the students in the course. One tangible benefit was the class time provided for reading one of eleven booklets required normally for out-of-class reading. Future student populations will benefit because if the results had been negative, the development process would have been reinitiated. Some students may feel a degree of satisfaction for contributing to the development of effective instructional materials.

The concern for the worth of the study was raised primarily by the evaluation staff at the Center. Is it desirable to attempt this type of study within an instructional development agency? The amount of instructional material available on the market without sufficient, stated measures of student achievement suggests that a strong professional obligation exists for the Center to conduct such a study. The absolutism of the Joint Committee's Recommendation was questioned by the evaluation staff because of the required commitment of time

and money. However, the increased credibility from the objective knowledge of the materials' instructional effectiveness has caused the evaluation staff to support the recommendation with a full awareness of the complexity of operationalizing the recommendation.

APPENDIX

Staff -- Drugs in Perspective

Project Director

Walter M. Higley II
Director
Drug Education Project
School of Social Work
Syracuse University
Syracuse, New York 13210

Development Staff

Paul E. Eickmann, Ph.D.
Associate Director for Development
Center for Instructional Development
Syracuse University
Syracuse, New York 13210

Frank Wilbur
Development Intern
Center for Instructional Development
Syracuse University
Syracuse, New York 13210

Programmed Booklet	Author	Developer
Amphetamines	Cheryl Milkes and Walter M. Higley II	Dr. Paul Eickmann served as Developer for all the booklets.
Barbiturates	Cheryl Milkes and Walter M. Higley II	
Caffeine	Cherly Milkes and Walter M. Higley II	
Cocaine	Ellen N. Goldman and Walter M. Higley II	
Drug Definitions	Cheryl Milkes and Walter M. Higley II	
Marijuana	Cheryl Milkes and Walter M. Higley II	
Tranquilizers	Cheryl Milkes and Walter M. Higley II	

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